

WHAT IS CLAIMED IS:

1           1.       A method of aligning a plurality of images, the method comprising:  
2           providing a marker on a first image and a second image;  
3           overlapping the first image and the second image to match the marker on the  
4 first image with the marker on the second image; and  
5           computing an absolute difference value between the pixel intensities of the  
6 overlapping portions of the first and second images to validate alignment between the first  
7 and second images.

1           2.       The method of claim 1 comprising realigning at least one of the first  
2 image and second image if it is determined that the first and second images are misaligned.

1           3.       The method of claim 1 wherein the first and second images are  
2 obtained from a digital radiography device.

1           4.       The method of claim 1 comprising blending an overlap section of the  
2 first image and the second image.

1           5.       The method of claim 4 wherein blending comprises:  
2           computing a pixel intensity of the pixels of first image in the overlap section;  
3           computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5           displaying for each pixel in the overlap section a largest pixel intensity of the  
6 overlapping pixels from the first image and second image.

1           6.       The method of claim 4 wherein blending comprises:  
2           computing a pixel intensity of the pixels of first image in the overlap section;  
3           computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5           displaying for each pixel in the overlap section a smallest computed pixel  
6 intensity from the overlapping pixels from the first image and second image.

1           7.       The method of claim 4 wherein blending comprises:  
2           computing a pixel intensity of the pixels of first image in the overlap section;

3           computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5           displaying for each pixel in the overlap section an average pixel intensity of  
6 the overlapping pixels of the first and second images in the overlap section.

1           8.     The method of claim 4 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% of the first image to 100% of the first image in the overlap section.

1           9.     The method of claim 4 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% to 100% of the second image.

1           10.    The method of claim 4 wherein the first and second images comprise a  
2 plurality of pixels, each of the pixels having a pixel intensity, wherein in the overlap section a  
3 portion of the pixels in the first image overlap a portion of the pixels in the second image,  
4 wherein the overlap section comprises a first end and a second end, wherein blending  
5 comprises:

6           displaying 100% of the pixel intensity of the first image at the first end of the  
7 overlap section;

8           displaying 50% of the pixel intensity of the first image with 50% of the pixel  
9 intensity of the overlapping pixels of the second image at a halfway point of the overlap  
10 section; and

11          displaying 100% of the pixel intensity of the second image at the second end  
12 of the overlap section.

1           11.    The method of claim 10 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a non-linear manner from the first end of the overlap section  
4 to the second end of the overlap section.

1           12.    The method of claim 10 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a linear manner from the first end of the overlap section to the  
4 second end of the overlap section.

1 13. A method of stitching a plurality of images, the method comprising:  
2 providing a marker on a first image and a second image;  
3 overlapping the first image and the second image to create an overlap section,  
4 wherein overlapping matches the marker on the first image with the marker on the second  
5 image;  
6 calculating an absolute difference between the pixel intensity values of the  
7 overlapping portions of the first and second images in the overlap section so as to validate  
8 alignment between the first and second images; and  
9 blending the overlap section of the first image and the second image.

1 14. The method of claim 13 wherein the first and second images are  
2 obtained from a digital radiography device.

1 15. The method of claim 13 wherein blending comprises:  
2 computing a pixel intensity of the pixels of first image in the overlap section;  
3 computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5 displaying for each pixel in the overlap section a largest pixel intensity of the  
6 overlapping pixels from the first image and second image.

1 16. The method of claim 13 wherein blending comprises:  
2 computing a pixel intensity of the pixels of first image in the overlap section;  
3 computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5 displaying for each pixel in the overlap section a smallest computed pixel  
6 intensity from the overlapping pixels from the first image and second image.

1 17. The method of claim 13 wherein blending comprises:  
2 computing a pixel intensity of the pixels of first image in the overlap section;  
3 computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5 displaying for each pixel in the overlap section an average pixel intensity of  
6 the overlapping pixels of the first and second images in the overlap section.

1 18. The method of claim 13 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% of the first image to 100% of the first image in the overlap section.

1 19. The method of claim 13 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% to 100% of the second image.

1 20. The method of claim 13 wherein the first and second images comprise  
2 a plurality of pixels, each of the pixels having a pixel intensity, wherein in the overlap section  
3 a portion of the pixels in the first image overlap a portion of the pixels in the second image,  
4 wherein the overlap section comprises a first end and a second end, wherein blending  
5 comprises:

6 displaying 100% of the pixel intensity of the first image at the first end of the  
7 overlap section;

8 displaying 50% of the pixel intensity of the first image with 50% of the pixel  
9 intensity of the overlapping pixels of the second image at a halfway point of the overlap  
10 section; and

11 displaying 100% of the pixel intensity of the second image at the second end  
12 of the overlap section.

13 21. The method of claim 20 wherein blending further comprises displaying  
14 pixel intensities from the first image and the second image with a weighting for the  
15 combination which changes in a non-linear manner from the first end of the overlap section  
16 to the second end of the overlap section.

1 22. The method of claim 20 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a linear manner from the first end of the overlap section to the  
4 second end of the overlap section.

1 23. The method of claim 13 wherein the overlap section is black when the  
2 overlapping pixels of the first image and the second image have the same pixel intensity.

1 24. The method of claim 23 wherein calculating is in real-time.

1           25.    The method of claim 13 wherein providing a marker comprises  
2 marking a first point on the first image and a second point on the second image, and wherein  
3 overlapping comprises matching the first and second points and keeping the orientation of the  
4 first and second image fixed.

1           26.    The method of claim 13 wherein providing a marker comprises  
2 marking a first point and a first line on the first image and a second point and second line on  
3 the second image, wherein superimposing comprises:  
4                matching the first points and second points; and  
5                rotating one of the first and second images so that the first line and second line  
6 are parallel.

1           27.    The method of claim 13 wherein providing a marker comprises  
2 marking a first line on the first image and a second line on the second image so that a last  
3 point of the first line and a first point of the second line are matched and wherein overlapping  
4 comprises rotating at least one of the images so as to make the first line and second line  
5 parallel.

1           28.    The method of claim 13 comprising adjusting a position of at least one  
2 of the first and second images by a plurality of fixed steps.

1           29.    The method of claim 28 wherein the fixed step comprises a one pixel  
2 displacement.

1           30.    The method of claim 28 wherein the fixed steps comprise a 10 pixel  
2 displacement.

1           31.    The method of claim 28 wherein adjusting of the position of the  
2 image(s) is made in a fixed step by the use of a keyboard key or combination of keys.

1           32.    The method of claim 28 wherein the first image is rotated in a plurality  
2 of fixed steps by the use of a keyboard key.

1           33.    The method of claim 32 wherein the steps comprise a one quarter  
2 degree rotation.

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- 1                    34.     The method of claim 32 wherein the fixed step comprises a one degree  
2     rotation.
- 1                    35.     The method of claim 32 wherein the fixed step comprises a ten degree  
2     rotation.
- 1                    36.     The method of claim 28 comprising tracking the position of the moved  
2     image in real time.
- 1                    37.     The method of claim 28 comprising adjusting a center of rotation of at  
2     least one of the first and second image.
- 1                    38.     The method of claim 37 wherein adjusting comprises clicking and  
2     dragging a cursor over a selected image.
- 1                    39.     A method of stitching a first image and a second image:  
2             providing a first image and a second image;  
3             overlapping a portion of the first image with a portion of the second image to  
4     create an overlap section;  
5             calculating pixel intensities of the first image and the second image; and  
6             validating alignment of the first image and second image by displaying an  
7     absolute difference between a pixel intensities of the first image and the second image in the  
8     overlap section.
- 1                    40.     A method of blending at least a first and second radiographic image in  
2     an overlap section of a stitched image, the method comprising:  
3             computing a pixel intensity of the first image and second image in the overlap  
4     section of the stitched image; and  
5             displaying a smooth transition in the overlap section between the first and  
6     second image from 0% to 100% of the pixel intensity of the second image.
- 1                    41.     The method of claim 40 wherein displaying the smooth transition  
2     comprises:  
3             displaying 100% of the pixel intensity first image at a first end of the overlap  
4     section;

5 blending 50% of the pixel intensity of the first and second images at a half  
6 point; and  
7 displaying 100% of the pixel intensity of the second image at a second end of  
8 the overlap section;  
9 wherein the distribution of the smooth transition of the pixel intensity between  
10 the first end, half point, and second end varies with linear weighting.

1 42. The method of claim 40 wherein displaying the smooth transition  
2 comprises:  
3 displaying 100% of the pixel intensity of the first image at a first end of the  
4 overlap section;  
5 blending 50% of the pixel intensity of the first and second image at the half  
6 point; and  
7 displaying 100% of the pixel intensity of the second image at a second end of  
8 the overlap section;  
9 wherein the distribution of the smooth transition of the pixel intensity between  
10 the first end, second end, and half point varies with non-linear weighting.

1 43. A method of stitching at least a first and second image, the method  
2 comprising:  
3 providing a first and second image, wherein each of the first and second image  
4 comprises a plurality of pixels;  
5 overlapping a portion of the first image and the second image to create an  
6 overlap section;  
7 computing on a pixel by pixel basis an absolute difference value between the  
8 overlapping pixels of first image and the second image in the overlap section; and  
9 displaying the absolute difference between the pixel intensities of the  
10 overlapping pixels of the first image and the second image.

1 44. The method of claim 43 wherein the displaying comprises providing a  
2 black overlap section when the first image and second image coincide exactly within the  
3 overlap section.

1 45. A method of blending at least a first and second stitched image,  
2 wherein the first image and second image comprises pixels, wherein the stitched image

3 defines an overlap section in which portions of the pixel in the first image overlap with pixels  
4 in the second image, the method comprising:  
5           computing a pixel intensity for each of the pixels from the first and second  
6 image in the overlap section; and  
7           displaying a largest computed pixel intensity of the overlapping pixels from  
8 the first and second images.

1           46. A method of blending at least a first and second stitched image,  
2 wherein the first image and second image comprises pixels, wherein the stitched image  
3 defines an overlap section in which portions of the pixel in the first image overlap with pixels  
4 in the second image, the method comprising:  
5           computing a pixel intensity for each of the pixels from the first and second  
6 image in the overlap section; and  
7           displaying a smallest computed pixel intensity of the overlapping pixels from  
8 the first and second images.

1           47. A method of stitching a plurality of images, the method comprising:  
2 providing a first image and a second image;  
3 allowing a user to choose one of at least two types of markers to align the first  
4 and second images;  
5 marking the first image and second image with a chosen marker; and  
6 aligning the markers to stitch the first and second images together.

1           48. The method of claim 47 wherein allowing comprises letting the user  
2 choose from at least two of a single point marker, two point markers, a line marker, and a  
3 point and line marker.

1           49. The method of claim 47 wherein marking comprises marking the first  
2 image and second image with a point marker, and wherein aligning comprises performing at  
3 least one of a translation (with no rotation) of one of the images to align the markers on the  
4 first image and second image.

1           50. The method of claim 47 wherein marking comprises marking the first  
2 image and second image with two point markers, and wherein aligning comprises performing  
3 at least one of a translation and rotation of one of the images to align the two markers on the  
4 first image with the two markers on the second image.



1           51.    The method of claim 47 wherein marking comprises marking the first  
2 image and second image with a point marker and a line marker, and wherein aligning  
3 comprises performing at least one of a translation and rotation of one of the images to match  
4 the point markers on the first image and second image and to make the line markers parallel.

1           52.    The method of claim 47 wherein marking comprises marking the first  
2 image and second image with a line marker, and wherein aligning comprises performing at  
3 least one of a translation and rotation of one of the images to match one end of the line  
4 marker on the first image with an end of the line marker on the second image and to align the  
5 images such that the lines are parallel.

1           53.    The method of claim 47 comprising blending the images in an overlap  
2 section of the stitched image.

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1           54.    A method of stitching a plurality of images, the method comprising:  
2 providing a first image and a second image;  
3 allowing a user to choose one of at least two of the following methods of  
4 marking:

5                   marking a first point on the first image and a second point on the  
6 second image;

7                   marking a first and second point on the first image and a third and  
8 fourth point on the second image;

9                   marking a first point and a first line on the first image and a second  
10 point and second line on the second image;

11                  marking a first line on the first image and a second line on the second  
12 image;

13                  marking the first image and second image with a chosen marker; and  
14 aligning the markers to stitch the first and second images together.

1           55.    The method of claim 54 wherein marking comprises placing the first  
2 point on the first image and the second point on the second image , wherein aligning further  
3 comprises keeping the orientation of the first and second image fixed.

1           56.    The method of claim 54 wherein marking comprises placing the first  
2 point and the first line on the first image and the second point and second line on the second

3 image, wherein aligning comprises matching the first points and second points and rotating  
4 one of the first and second images so that the first line and second line are parallel.

1 57. The method of claim 54 wherein marking comprises placing the first  
2 point and second point on the first image and the third point and fourth point on the second  
3 image, wherein aligning comprises matching the first point with the third point and rotating  
4 one of the first image and second image until the second point and fourth points are matched.

1 58. The method of claim 54 wherein marking comprises placing the first  
2 line on the first image and the second line on the second image, wherein aligning comprises  
3 overlapping the first line and second line so that a last point of the first line and a first point  
4 of the second line are matched, wherein at least one of the first and second images are rotated  
5 so as to make the first line and second line parallel.

1 59. A stitched image comprising:  
2 a first portion comprising a first portion of a first image;  
3 a second portion comprising a first portion of a second image; and  
4 an overlap portion comprising a blended combination of a second portion of  
5 the first image and a second portion of the second image.

1 60. The stitched image of claim 59 wherein the overlap portion comprises  
2 a marker.

1 61. The stitched image of claim 59 wherein the stitched image comprises a  
2 DICOM dataset.

1 62. A method of measuring an angle of scoliosis, the method comprising:  
2 providing a first radiographic image of at least a portion of the thoracic and  
3 upper lumbar spine;  
4 providing a second radiographic image of at least a portion of the lumbar and  
5 lower thoracic spine;  
6 stitching the first radiographic image to the second radiographic image; and  
7 measuring an angle of scoliosis on the stitched radiographic image.

1 63. The method of claim 62 wherein measuring comprises placing two  
2 lines on the radiographic image and measuring the angle between the two lines.

1                   64.     The method of claim 62 wherein measuring comprises:  
2                   drawing a line in a disk space between two thoracic vertebrae parallel to an  
3 inferior surface of an upper vertebrae;  
4                   drawing a second line in a disk space between two lumbar vertebrae, parallel  
5 to the inferior surface of an upper lumbar vertebrae;  
6                   drawing a line perpendicular to each of the first and second lines such that the  
7 lines intersect; and  
8                   calculating the angle at an intersection.

1                   65.     The method of claim 62 comprising blending an overlap section of the  
2 first radiographic image and the second radiographic image.

1                   66.     The method of claim 65 comprising validating a registration of the first  
2 image and second image by displaying an absolute difference between the first image and  
3 second image in the overlap section.

1                   67.     A method of stitching a first image and a second image, the method  
2 comprising:  
3                   providing a first marker on a first image and a second marker on the second  
4 image, wherein each of the first image and second image comprise a plurality of pixels;  
5                   matching the first and second markers, wherein matching overlaps a portion of  
6 the first image and a portion of the second image;  
7                   validating alignment of the first image and second image by displaying an  
8 absolute difference of pixel intensities of the overlapping portions of the first image and  
9 second image; and  
10                  blending the overlapping portions of the first image and second image.

1                   68.     A method of stitching a first image and a second image, the method  
2 comprising:  
3                   providing at least a first marker on a first image and at least a second marker  
4 on the second image, wherein the first image and second image comprise a plurality of pixels;  
5                   matching the first and second markers, wherein matching overlaps a portion of  
6 the first image and a portion of the second image; and  
7                   selecting a desired blending method from a plurality of blending methods; and

- 8                    using the selected blending method to blend the overlapping portions of the
- 9   first image and second image.